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Forest owners' attitudes toward pro-climate and climate-responsive forest management

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ABSTRACT

Climate change is a global concern. Within Nordic countries such as Finland it has particular influence on the use of natural resources. Family forest owners own 61% of the forested land in Finland and 80% of the industrial roundwood purchased comes from these forest owners. Thus how private forest owners approach climate change is of high national economic and ecological importance. In order to understand family forest owners' perspectives on climate change in their own forests, qualitative interviews along walks through the owner's forests were conducted. Analysis of the conversations during these walks highlighted that forest owners discussed the phenomenon without prompting more often than hypothesized. Additionally, forest owners were less certain as to the causes of changes observed in their forests, mostly willing to take advice from professionals, and economically-driven in their response. For those forest owners who did express concern regarding climate change, they were at a loss for ways their efforts could make a meaningful difference. The prevalent uncertainty among forest owners calls for guidance from authority. Policy practices should make an effort to combine monetary incentives along with climate change focused forest management practices. Additionally, forest owner's reliance on the advice and expertise of forestry professionals should be utilized when pursuing climate-motivated forest management.

1. Introduction

Climate change is having and will continue to have a distinct effect on boreal forests in the northern hemisphere (Harris et al., 2009; IPCC, 2014). Such effects include shorter periods of ground frost; northward movement of the forestline; reduced snowfall and snowpack; increased risks for fire, wind throw, and drought; and timber damage as a result of insects and fungi (Harris et al., 2009; Volney and Fleming, 2000; Stocks et al., 1998). Not only will these changes affect forest composition but they can and should also alter the practices of forest management by landowners (Eriksson, 2014; van Gameren and Zaccai, 2015; Lawrence, 2017; Sohngen and Tian, 2016). Thus, climate change is and will continue to be a major change factor for private forest owners in their forest management decisions.

Not all effects of climate change are considered to be negative though (Blennow and Sallnäs, 2002). With increased annual temperatures comes the potential for less hardy tree species from more southern latitudes to survive the winters. The advent of certain non-native species can be a source of higher revenue in the timber market, and native species may grow with increased vigor given increased rainfall and shorter winters (SCCV, 2007). On the other hand, invasion of non-native species is been considered as one of the most severe threats facing forests globally, and possibly catalyzed by climate warming (Dale et al., 2001; Hansen et al., 2001; Pimentel et al., 2005).

Researchers often view forest management in the face of climate change through two different lenses: mitigation and resilience, where mitigation is the forest's role in sequestering atmospheric carbon back into the earth (Canadell and Raupach, 2008) and resilience is the forest's capacity to maintain and reshape its current structure and functioning in the face of a changing climate (Folke, 2006). Theoretically, forest owners' adaptation to climate change can include both of these elements. They can change the forest structure pre-emptively in order to maintain or enhance the forest's resilience and production capacity (D'Amato et al., 2011; Blennow et al., 2012). Likewise, they can aim to

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mitigate climate change through carbon binding and storage (e.g. Håbesland et al., 2016; Khanal et al., 2017; Latta et al., 2016). In contrast to the pre-emptive measures, climate change mitigation is best pursued by inactivity in forest management.

Each climate change approach has a place within forest management not only at the national level but also within the management plans of non-industrial private forest owners (hereafter forest owners), who provide ecosystem services to their communities and are working to keep their forests productive for decades to come. Climate change considerations are especially important in parts of the boreal forest that are dominantly owned by private individuals and families. For example, in Finland over 60% of the forested land is in the possession of forest owners and over 80% of all roundwood purchased by the forest industry in Finland comes from forest owner land (Hänninen et al., 2011; Parviainen and Västilä, 2011). The individual decisions that forest owners make will collectively have a large influence on the overall forest landscape, climate, and economy of Finland, and the situation is relatively similar also in other private-forested countries in Europe, such as Sweden, Austria, and Slovenia.

Therefore, it is an important policy objective to support "pro-climate" decisions of forest owners through mitigation practices as well as "climate responsive" decisions for improving the forest's resilience. Making policy programs coherent and influential requires deep understanding on how forest owners think about climate change and how they see themselves in the larger framework of this global issue, which is distinctively uncertain (Zhou, 2015): it is important to study not only climate change on boreal forests, but also climate change perceptions, observations, and attitudes of the forest owners (Hopkins et al., 2017). Adaptive capacity of human communities shapes, through forest management decisions, the resilience of forest ecosystems in the face of climate change. In addition, understanding forest owners' perceptions toward climate change could bring up new insights when considering service provisioning for forest owners (Valatin et al., 2016).

Forest owners' motivations to join with carbon sequestration programs have been focused on several studies (e.g. Håbesland et al., 2016; Latta et al., 2016; Valatin et al., 2016; Khanal et al., 2017), but only few holistic studies on pro-climate and climate responsive dimensions have been conducted in the context of forest owners. In Canada Bissonnette et al. (2016) found out that forest owners did not perceive vulnerability to climate change to be linked to their forests or activities in them, and Grotta et al. (2013) found out that most forest owners did not plan to make changes in their forest management due to anticipated climate change. In Belgium van Gameren and Zaccai (2015) found that landowners were not adapting to climate change and the reasons for the lack of adaptation varied based on sociocognitive factors and multiple objectives. Furthermore, studies from Sweden are emphasizing that both personal experiences and beliefs should be taken into account when working on climate change policy communication:

- Landowners who believed to have experienced the effects of climate change are more likely to take measures to adapt to climate (Blennow, 2012; Blennow et al., 2012).
- Most often, landowners observed changes to their forests such as insect damage, wind throw, increased drought, and fungal diseases (Blennow, 2012).
- Adaptation to climate change is strongly related to forest owner's belief in climate change (Blennow and Persson, 2009).
- Landowners' strength of belief in the adaptability of the forest is related to their adoption of adaptive measures (Blennow and Persson, 2009).

The idea that climate change is not readily understood and accepted comes from the understanding that weather fluctuations are a natural part of climate patterns, and larger over-arching changes are harder to detect through normal human experiences (Blennow et al., 2012). When a phenomenon is hard to observe as actually occurring it can then be hard to take action to respond. This is particularly true for forest owners, who can have a hard time distinguishing the effects of climate change from normal functions and disturbances in their forests. Higher education of forest owner may increase awareness, and perception of risk (Blennow et al., 2016) and participation to targeted policy programs (Hopkins et al., 2017).

A qualitative study by Eriksson (2014) highlighted the finding that landowners were overall unconcerned about forest risks, be it fire, drought, or insect damage, and highlighted a foundational two-dimensional framework for categorizing and understanding forest landowners. These two categories, perceived risk tolerance and perceived control, and the placement of a landowner in them, was influenced by the role of the forest within the finances of the forest owner, past experiences with risk to the forest structure, forest values, and the vulnerability of the forest overall (Eriksson, 2014). Eriksson's (2014) study allowed landowners to come up with their own ideas of which risks were threatening their forests, and climate change was not immediately introduced. Interestingly, not primed with the thought of climate change, only 10% of the interviewees mentioned it.

1.1. Objectives and research questions

Though some work has been done on this intersection of climate change and forest owners in Europe, most has thus far occurred in Sweden (Blennow, 2012; Blennow et al., 2012, 2016; Blennow and Persson, 2009; Blennow and Sallnäs, 2002; Eriksson, 2014). Thus, the issue is still a highly unexplored field. In many countries where forests play a major role in the national economy, such as Finland, there are currently no studies available.

Using psychological theories on behavioral change, particularly the theories of the tripartite model of attitudes and the theory of planned behavior as a vantage point, this study seeks to add to the existing knowledge of forest owner's attitudes toward climate change through a qualitative and mixed-methods approach. This study contributes to the international forest science knowledge base by acting as validation on previous studies related to forest owners climate change attitudes. Thus, this study explores the following three research questions and hypotheses, respectively, developed from the initial work conducted by Blennow and Sallnäs (2002), Blennow and Persson (2009), Blennow et al. (2012), and Eriksson (2014):

Research Question 1, cognitive element of attitudes: What is the role/position of climate change in the Finnish forest owners' perceptions of change in their forest and forest management?

H1. Few landowners consider climate change to be a fundamental force affecting their forest, and when prompted, their considerations primarily focus on increased risk of forest damage.

Research Question 2, affective element of attitudes: What affective statements do forest owners associate with impacts of climate change in their forests?

H2. Land owners are not primarily concerned that climate change will have a substantial impact in their forests.

Research Question 3, behavioral element of attitudes: How prepared are forest owners to adapt their management practices in response to climate change? What behavioral control statements do forest owners associate with their intentions toward climate-responsive forest management?

H3. Forest owners have not adapted their management practices to consider climate change but those who have observed negative impacts of climate change in their forests are more willing to adopt climate-responsive forest practices than those who have not perceived any impacts.

2. Theoretical orientation

2.1. Attitudes and behavior regarding forest owners' actions

Understanding the attitudes of a subject or focal group is important in any study that explores decision-making and willingness to adopt new practices. This is true for those necessary to mitigate climate change through carbon sequestration or to improve resilience of forests to climate change. Attitude-based studies have been applied to climate change studies where the focus group comprised resource managers (Rodriguez-Franco and Haan, 2015). Other studies that utilized attitude analysis include those focusing on timber harvesting, forest landowners, and management plans, to name a few (Uusivuori, 2002; Elwood et al., 2003; Blennow et al., 2014).

Multiple working definitions of "attitude" exist but the common denominator with each is that attitude consists of several mental components, often presented as a hierarchy (Katz and Stotland, 1959; Rosenberg and Hovland, 1960). This hierarchy of attitudes can be understood through multiple theoretical frameworks from the fields of psychology and social science though some common themes are highlighted in each (Breckler, 1984; Klop and Severiens, 2007; Watson et al., 1995). Attitude requires an awareness of the specific person, place, thing, or event. This includes beliefs regarding the issue which in turn guides the subject to a given intention and finally a behavior toward the issue. These three components - cognitive, affective and behavioral - together form a subject's attitude. This three-stage model of attitudes is often referred to as the tripartite model of attitudes (Breckler, 1984; Klop and Severiens, 2007; Rosenberg and Hovland, 1960).

However, most behavior-oriented attitude studies emphasize that the link from cognitive awareness and beliefs to behavioral intention and action is not straightforward. This is due to the fact that behavior is largely socially determined (Rosenberg and Hovland, 1960; Schwartz, 1994). Thus, in addition to attitudes, theories of behavior include components regarding what is perceived as feasible and socially acceptable or preferable. The Theory of Planned Behavior (TPB) provides a framework to understand control mechanisms which influence a subject's actions. The TPB purports that action is preceded by control mechanisms including injunctive and descriptive norms, and perceived behavioral control; indicating that not only do a subject's attitudes determine their actions but also the pressures of their social environment. Thus the social environment acts as an added layer that can help or hinder a subject's practical capability to actualize behavioral intentions (Ajzen, 1991, 2011; Ajzen et al., 2011).

The TPB has been successfully used by conservation and forest scientists to understand attitudes and behaviors of stakeholders regarding issues such as climate change, carbon sequestration, reforestation methods, and bioenergy (Becker et al., 2013; Halder et al., 2016; Karppinen, 2005; Karppinen and Berghäll, 2015; Thompson and Hansen, 2013). Such econometric studies focused on searching structural, population level factors explaining how forests owners adopt new policies.

3. Materials and methods

3.1. Analysis approach

The approach of this study is qualitative and we are working at the individual behavioral level. Comparable qualitative study setting was used by Eriksson (2014) on climate change attitudes; and more generally qualitative approach has got increasing attention to study forest owners' perceptions to many policy relevant phenomenon (e.g. Salomaa et al., 2016; Guillen et al., 2015; Fischer, 2012; Vainio and Paloniemi, 2012). Regarding to detailed study constellation all studies are unique compared to other studies. In this study we use "forest walks" as data collection method and the TPB to complement the tripartite model of attitudes in framing theoretically forest owners' understanding of and attitudes toward climate change as it relates to their forests (Fig. 1).

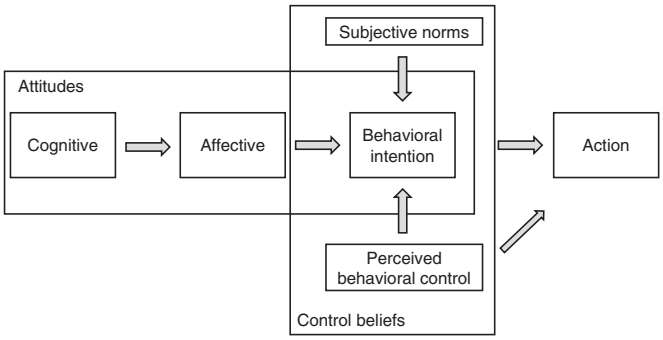

Fig. 1. Analysis framework of this study applying the tripartite model of attitudes (Rosenberg and Hovland, 1960) and the theory of planned behavior (Ajzen, 1991, 2011).

In this study we are particularly interested in forest owners' behavior related to mitigation of climate change and to increasing adaptive capacity in their own forest. A landowner holds certain cognitive beliefs regarding climate change. These beliefs are combined with affective evaluations of the issue to generate a behavioral intention that the landowner holds regarding climate change in their forests. In addition to personal beliefs and evaluations regarding climate change, landowners are also influenced by subjective norms and the perceived capability to realize their behavioral intentions. These two dynamics are shown in the control portion of the model and also represent the application of the TPB. Societal pressures and support essentially influence control beliefs. Both attitude and control work together and influence each other to determine what, if any, action(s) a landowner may make regarding climate change. The action(s) can be either receptive or opposing compared to dominant beliefs in society.

3.2. Cognitive mapping

In order to capture the intricacies and interactions among the concepts related to attitudes and behavior we applied the cognitive mapping (CM) approach to capture the specific mental structures of the landowners. CM is a technique used to collect perceptions and thoughts from the subject and reflect them back in an organized and coherent way (Eden, 1988). It is based of three premises, specifically: 1. A person is able to understand their world through similarities and differences, 2. A person has the desire and drive to explain and make sense of their world, and 3. A person seeks to understand their world by hierarchically organizing concepts in their mind, where some are more important than others (Kelly, 1991). CM is especially useful as a means of understanding people's beliefs and conceptions about the world (Kaplan and Kaplan, 1989). These beliefs can then be used to develop a framework for introducing new ideas and developing appropriate responses to new issues (Kaplan and Kaplan, 1989; Kearney and Kaplan, 1997).

3.3. Data collection

In order to understand forest owners' perceptions of climate change in their forests, 20 landowners were interviewed. Forest owners were selected from a stratified random sample of individuals owning forests and living in the study area which is located in Eastern Finland, near the city of Joensuu (Fig. 2). From the interviewed forest owners 17 were male and three were female. In addition to the interviewed forest owners, in four interviews there was another person participating as well. In two cases the other person was the female forest owner's husband, with whom they do forest related decisions together, and in two cases the other person was a trusted individual who helps the forest owner in general.

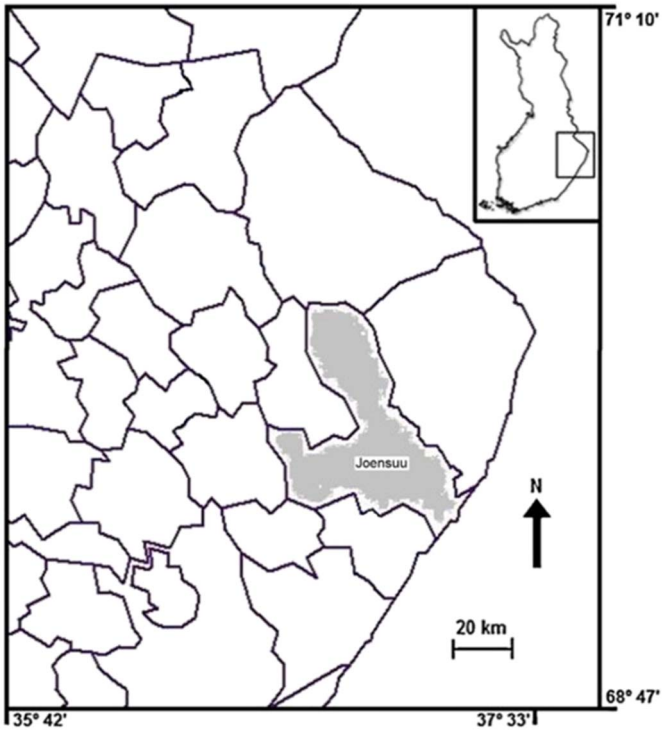

Fig. 2. Map of the study area in Eastern Finland.

Walking through the forests of the interviewees was used as a framework to structure the interviews which is why it was operable to interview only forest owners who lived right next to or near (in the same municipality) their forests. Walks were conducted in the summer of 2015. The interviews were recorded using two separate voice recorders, one carried by the interviewee and the other by the interviewer.

Conducting walking interviews is a good way to explore people's relationships and perceptions of a certain environment (Jones et al., 2008; Winkler, 2002). Thibaud (2001) introduced the method of exploring perception through "commented walks" (cited by Sawatzky, 2013). Even though commented walks are mainly used in urban spaces, they are valid also in more natural areas (Sawatzky, 2013). Commented walks are an attempt to observe and capture impressions and perceptions that may be forgotten when away from the focus area (Winkler, 2002). Commented walks also allow the interviewee to be taken into a different environment where even just the act of walking can create new and even unexpected types of data (Jones et al., 2008). Walking in a changing environment can result in less inhibited perceptions because both the interviewee and interviewer are moving through the same environment and sharing the same experience. Also, removing the table or desk and allowing both parties to walk side-by-side removes the possible feelings of an uneven power dynamic (Winkler, 2002).

The "forest walk" interviews in this study had six phases (Fig. 3). (1) In the first phase relevant background information was asked, e.g. sex, year of birth, tenure, and what objectives were most relevant concerning the forest. (2) In the second phase of the interview cognitive mapping was used by asking the forest owner to state all changes they had noticed in their forest, in forest management and decision making, and generally related to forests and forestry. The timeline for these changes was limited to the landowner's period of ownership or as long as they had observed the forest's development. The purpose of the cognitive mapping was to encourage the forest owners to mention as many observed or perceived changes as possible from their own viewpoint. Each mentioned change was written down on a re-adherable piece of paper. In addition, the forest owner was asked to identify three most important changes, justify the selection, and consider causes and consequences related to the changes. The first two phases were done in the interviewee's home and the remaining phases were conducted in the forest.

(3) The third phase of the interview was the actual forest walk. The forest owner was told to think of two places in their forest where they noticed changes or were planning to adjust their forest management practices based on perceived changes. The forest walk was conducted as an open-ended theme interview (Dutcher et al., 2004; Rickenbach et al., 2004). The themes discussed included observed or perceived changes in the forest; adaptation i.e. changes in the forest management and usage; forest related services and guidance and motivation toward forest management and usage; and perceived future management. During the forest walks the visited places were photographed with the forest owner's permission.

The forest walks were meant to be owner-led and as undisturbed as possible, meaning that the forest owner was encouraged to speak as freely as possible about their forests and forest related matters in general. The term "climate change" was not mentioned on purpose, but if the forest owner's comments were closely related to the topic of climate change the interview was directed toward the topic.

(4) The fourth phase was closing the cognitive map by asking forest owners to group the changes mentioned and written down on the re-adherable pieces of paper earlier. At this point there was also the possibility to add new components if something came up during the forest walk. After possible additions, the forest owner was asked to group the mentioned additions so that those closest to each other or most related were in the same group. They were also asked to justify their grouping choices. Lastly, the forest owner was asked to give a representative name to each group. Before ending the fourth phase the cognitive map was photographed.

(5) The interview's fifth phase started by introducing a summary of Finnish research done related to climate change and its possible effects on forests as well as on how forests could adapt to those changes. In this phase the forest owner was asked to share their opinion about the summary, as well as in general about climate change.

(6) In the last phase the forest owner was asked to answer two short quantitative questionnaires about climate change and personal values.

The interviews were recorded, transcribed and saved using NVivo software for qualitative analysis (version 11). The interviews lasted from just over 1 h up to 3 h and 30 min. After conducting the interviews, there was about 470 pages of written text, 20 pictures of cognitive maps and 52 pictures from forest.

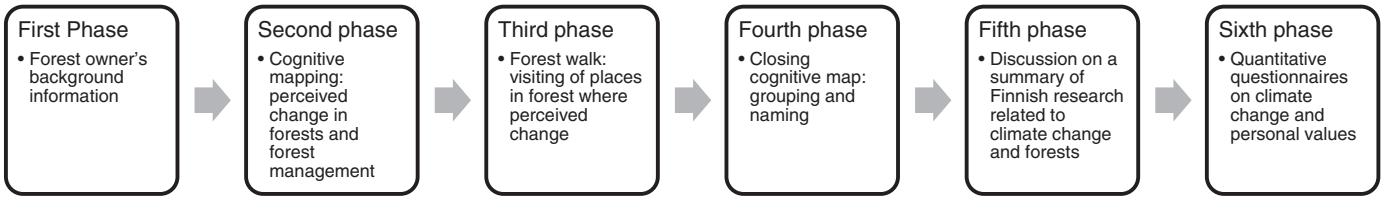
First Phase
• Forest owner's background information
Second phase
• Cognitive mapping: perceived change in forests and forest management
Third phase
• Forest walk: visiting of places in forest where perceived change
Fourth phase
• Closing cognitive map: grouping and naming
Fifth phase
• Discussion on a summary of Finnish research related to climate change and forests
Sixth phase
• Quantitative questionnaires on climate change and personal values

Fig. 3. Phases of the data collection.

3.4. Data analysis

3.4.1. Cognitive mapping of forest owners change beliefs and climate change therein

In order to explore the first research question on the cognitive dimension of attitude, the cognitive mapping data was structured in a data-sheet according to the issues raised by the forest owners. The data consisted of verbatim messages, comprising one idea each, given by the respondents, variables identifying the respondents and groups of messages constructed by the respondents, group labels in the format given by the respondents, a rationale statement of grouping by the respondent, and information on whether the particular message was evaluated to be among the three most important ones. These elements of the data were a starting point for the qualitative analysis of the messages to merge individual cognitive maps and to visualize an overall cognitive map.

The content analysis of the messages in the cognitive mapping data were conducted first separately by two researchers resulting in a partially different ideas on how messages could be categorized. After analysis they compared their findings and developed joint categories (later: message classes). Next codes were given to message classes and both researchers coded messages into these classes. After this individual exercise they compared results and re-coded messages that were originally coded differently. The final product consisted of 40 different message classes which were first agreed upon by the two researchers who had developed the initial categories and later confirmed by others on the research team.

In the first phase of quantitative analysis, the message classes were cross-tabulated with respondents with a particular aim to generate distribution of climate change related message classes among the interviewees. Second, the cross-tabulation of message classes by group labels given by respondents served as a starting point for constructing a symmetric class-by-class proximity matrix, serving data for proximity calculations. In this procedure 3CM cognitive mapping methodology by Kearney and Kaplan (1997) was followed. The cells of the matrix depict how close two classes of change messages are in the overall cognitive structure of respondents. The final proximity measure depicts in percentiles how often two message classes are grouped under the same label by respondents. The calculation procedure is described in detail elsewhere (Kearney et al., 1999; Tikkanen et al., 2006). The results of the cognitive mapping tasks are illustrated (Fig. 4) in the form of a mental network in two-dimensional scaling space of non-metric multidimensional scaling procedure (Borgatti et al., 2013). The NetDraw software was applied to visualize results (Borgatti, 2002): the ego-networks were drawn using two climate-related message classes (Climate warming and climate warming as a threat) as starting point in visualization, all connections depicting closeness greater than 0 were shown in the map.

3.4.2. Affective, behavioral and control components in forest owners' attitudes toward climate change

The entire transcript from all phases of data collection was coded in order to identify sections of the data including climate related narratives. This coding resulted altogether 32,900 words of data targeted to theory-driven analysis for finding sections including meaningful narratives on (1) affective evaluations of climate change related issues, (2) behavioral intentions, (3) normative control and (4) personal control perceptions (see Fig. 1). Findings located in those codes were then analyzed using the normal data-driven content analysis procedure (Green, 2004).

In the following results section direct quotations are separated in *italics* from the main text. Three dots (…) mean that a part form the narrative is cut away. Square brackets ([…]) separate wordings by the present authors used to make sentences in quotations understandable. Normal brackets in the end of quotations show the ID of the forest owner.

4. Results

4.1. Forest owners' attitudes toward climate change

4.1.1. Climate change in forest owners' cognitive structure regarding change

From the cognitive mapping exercise, seven messages by five (25%) of the forest owners were directly related to climate change. Three of those messages considered climate change as a threat, because natural "*quirks*" (FO20) in the weather were becoming more regular and harvesting conditions more challenging due to milder winters. The rest of the messages were more neutral or highlighted more favorable impacts of climate change, due to longer summers and because "*if you are able to utilize improved growth, you can make money*" (FO8). None of the messages directly referring to climate change were considered among the three most important change factors by the owners.

Quantitative proximity analysis of message classes produced two different climate related mental orientations (Fig. 4). Three of the forest owners considered climate change as a threat by connecting it with increasing forest damages such as insects and moose. This rhetoric orientation can be labelled as a concern orientation. Biodiversity, hunting, mushrooms, and berries were linked with climate change as a threat via short paths, thus the concern orientation was close to diversified forest management in the cognitive structure of the informants. Also, changes related to forest governance (land-use changes, ownership changes) were close to this orientation. In the map, nature protection (i.e. totally non-managed forest) was considered as threat along with climate change. The rationale behind this was consistent with the dominant forest management orthodoxy emphasizing that well managed forests are most resistant with different sort of damages. "*With certain issues there are only small influencing possibilities with nature … saying that the better they* [forests] *are managed the less* [snow damage] *there is*." (FO17).

Another concept that was highlighted and illustrates the dominant forest management orthodoxy was that of "climate change utilizers". As the name suggests, such landowners view the changes in their forests as a result of climate change as a benefit to their business. The change message "climate-warming" shown in the network and serving as an ego-node is used to represent this point of view. Two forest owners spontaneously raised this message class in their cognitive maps. This orientation was connected with the potentially positive impacts of climate warming due to increased forest production. Additionally, changes in species composition in the forest is also possible. Some forest owners had even started to actively diversify tree species composition in their forests, aiming at some future point to produce "*value*" timber from the deciduous tree species better at surviving in milder climates (FO3). This orientation was connected to positive connotations of forest management as a hobby. None of these forest owners considered their forests as a possible carbon sink or ecosystem service but instead thought of it as a potential source of income in the future.

In addition to the messages included in the cognitive maps, reported above, six of the interviewees brought up climate change related issues without prompting after the cognitive maps were closed. Their thoughts on climate change were similar to those depicted in the cognitive map discussed above. In addition, wind and snow damages were mentioned as a potential threat, and both negative and positive impacts to logging conditions were mentioned.

4.1.2. Forest owners' affective evaluations of climate change and forests

Affective evaluations that interviewed forest owners did include were the perceptions toward climate change in general and in relation to their forests specifically. Also, comments regarding climate change in general can be considered as indications of forest management related climate beliefs because all comments reported in this section were inspired by the forest walks in forest owner's forest. Among the interviewed forest owners there were those that did not believe in the phenomenon.

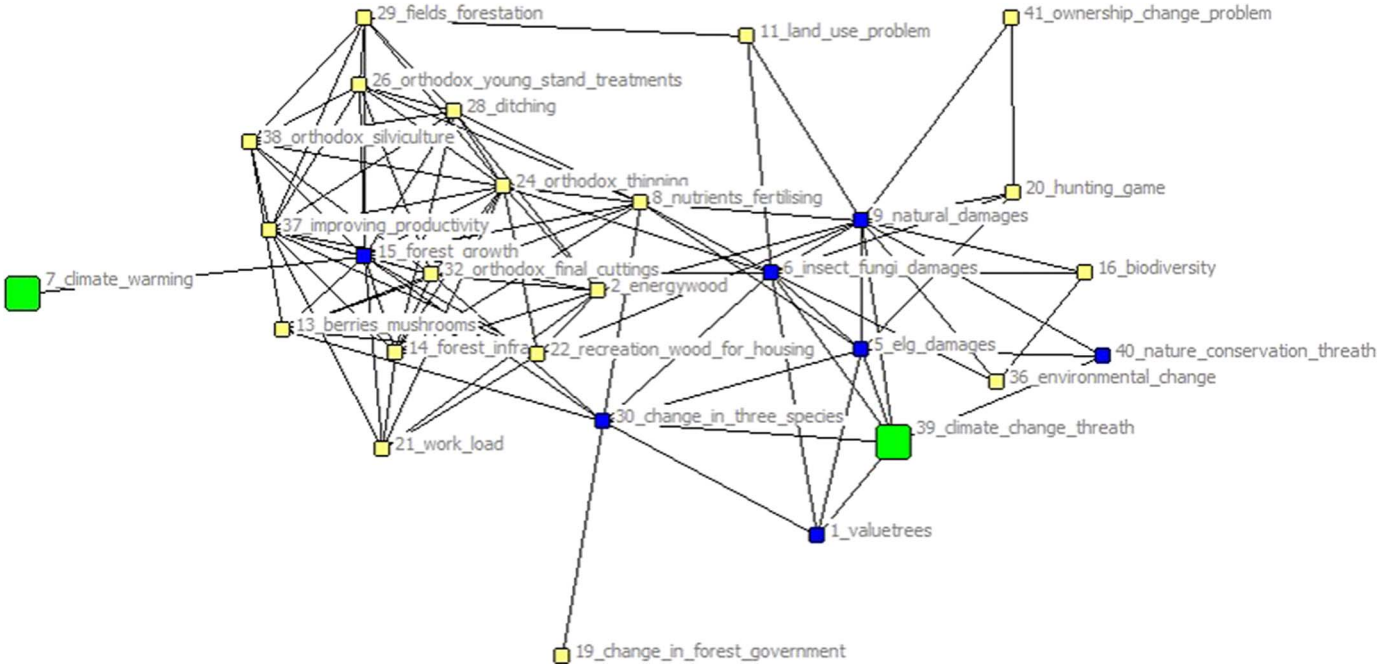

Fig. 4. Graphical illustration of a mental concept ego-network drawn from the cognitive maps of change perceptions among forest owners. Directly climate-related message classes are as egos and depicted as green color, the blue color depicts message classes in path-distance one and the rest (yellow) are in path-distance two from the egos. The map was produced in NetDraw software, with standard layout of non-metric scaling (Borgatti, 2002). (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

> "*I would not believe in* [climate change]…. *The average temperatures have not risen here in Finland and North Karelia. Yes, the increase has been very small.*" (FO4).

The most common response regarding climate change by the forest owners was uncertainty and a lack of understanding on how climate change could impact their forests. Furthermore, some of the forest owners were not interested in the topic at all.

> "*Honestly speaking I think that no-one really knows about this thing [*climate change*] either so much. But there are many people who speak as much they can. But as everyone talks in a different way, how can you know? And no-one knows at the end what will happen. Regarding this I am not very interested.*" (FO1).

Consistently, uncertainty, skepticism and avoidance were sentiments among forest owners regarding the changes they identified in the forests. Interestingly, there was not a strong signal that climate change was the culprit of the changes seen.

> "*I don't know if warming means anything for trees. I don't believe that there is at least any big change going to happen for these forests due to climate change which is discussed.*" (FO4).

> "*Well, yes, there has been, of course, always storms which fall trees here. Maybe they have become more frequent lately.*" (FO5).

> "*Now it was the possible climate change. I think that forest growth has increased, also due to long-term state actions.*" (FO8).

When the topic of climate change was broached many landowners were able to identify ways the changes could be beneficial. Specifically, they identified a shorter rotation period and longer growing season as benefits of climate change.

> "*Well, yes I guess it is the speed of growth* [as a change in the forest plot during next 30 to 50 years] *if the climate change progresses and other things that they foresee. I guess growth speed increases also in this region…final cut age being close to 60 to 70 years if it has been earlier 80 to 100 years.*" (FO10).

4.1.3. Forest owners' actual and intended behavior and control beliefs toward climate change in their forests

Regarding actual behaviors, forest owners represented a diverse array of responses from actual climate responsive behavior to the opinion that no behavioral changes were needed. One forest owner reported having actually made management changes related to climate change, i.e. planted oak and ash because the climate is now "*more favorable*" than before (FO3), but mostly forest owners had no intention of modifying their activities to include pro-climate or climate change-driven responses. Even though some forest owners have observed, for example, more wind damage as a new change factor, behavioral changes caused by climate change were not reported.

In general, there seems to be little urgency in relation to modifying behavior even though changes to the forests had been observed by the forest owners. However, another forest owner reported that he is "*carefully considering management options*" for a changing environment, especially with regards to logging operations (he did not use natural regeneration due to increased risk of storm damage) (FO14). A few interviewees gave critical pragmatic consideration to climate responsive behavioral changes. "*As we do not know enough we should be wide-awake* [to adapt actions]" (FO16). "… *storm damages, impact* [of them] *on the human being is small … if* [impacts are] *essentially visible, businesses should be adapted, then time span is long, you cannot cut down all spruces but has to grow them until to end* [of rotation]" (FO17).

There appears to be a low perceived behavioral control, in the context of climate change, experienced by the interviewed forest owners in relation to taking action in their own forests. A few forest owners pointed out that monetary issues, specifically external funding, matter in regards to the forest management choices they make, for instance, when asking about interest in carbon capture. "*If I can get compensation* [for carbon capture]*, why not* [to participate in it]" (FO18).

Many forest owners seem to have a clear, orthodox, idea of how forests should be managed but at the same time they have little information on how to adjust their management activities in light of a changing climate. Some forest owners considered themselves to be unable to affect change. "*It* [climate change] *is such an issue in which I*

cannot much affect" (FO16). A few forest owners mentioned their age as a limiting factor for forest related actions, for instance related to carbon capture. "… *cannot do so much anymore. I have age so much.*" (FO7). A few interviewees were confident in the abilities of the forestry professionals. "*Yes I trust in professionals in the forest management association, for sure the information is reliable*" (FO5). "*Then later we know if* [the information] *was correct or not.*" (FO18).

5. Discussion and conclusions

5.1. Synthesis of forest owners' possible climate change positions

The conversations with forest owners and analysis of their responses highlighted that landowners have a wide array of opinions and perceptions when it comes to climate change. Their behaviors and attitudes are affected by actual observations of the forest but are compounded by personal beliefs, social pressures, financial barriers, and their knowledge base. In order to bring together these attitudes in a coherent way a graphical representation was created by qualitatively locating illustrative quotations from the transcripts into a two-dimensional presentation. Quotations were located according to joint discussion by all authors of the paper (Fig. 5). This representation is inspired by a similar one published by Eriksson (2014) but grounds on the present empirical results.

In Fig. 5 theoretical climate attitudes are depicted in dimensions of strength of belief regarding behavioral control, and strength of belief toward climate change, in the landowners' own forest. Strength of belief toward climate change integrates cognitive beliefs on climate change and affective evaluations of them, and strength of belief on behavior control is related to the landowner's perceived control over climate change. Subjective control beliefs and social norms, from TPB, are also included in the dimension of control beliefs.

To aid in understanding forest owners' attitudes toward climate change within their own forests, the quotations derived from forest owners' were divided into four positions. These positions represent an ideal type of a forest owner, rather than an existing individual, constructed with the aid of the narratives presented by the interviewed forest owners. The reason behind this approach was that individual forest owners can hold versatile and even opposing attitudes toward climate change and therefore it is more reasonable to identify possible orientations that forest owners might represent. The positions are deniers, pragmatists, fatalists and purists. Deniers actively dismiss (opposing behavior) the phenomenon of climate change and the role of forests within the framework of climate change (Fig. 5 narrative C). Pragmatists may be skeptical or uncertain about climate change as a problem but are still acting responsively as a precaution to the possibility of climate change (risk averse attitude) (Fig. 5 narratives A, D and H). Additionally, pragmatists may also be performing climate change responsive actions inadvertently by meeting other management goals (as "climate utilizers" by the aid of i.e. carbon credits, hobby, landscape…, as like Håbesland et al., 2016, and Khanal et al., 2017 found that importance placed on non-market forest amenities is among the predictors of forest owners participation to carbon credit schemes). Fatalists are well aware of and understand the problem of climate change as well as the role of forest management decisions therein, but do not consider any of their own actions meaningful enough to affect or mitigate change (Fig. 5 narratives I and J). Climate purists are those who act according to serious concerns facing forests because of climate change (Fig. 5 narrative E). Between those extremes there are inevitably varying attitude combinations. The intermediate group unconcerned ponderer, including forest owners who are least aware of climate change and the role of forests therein is feasible (Fig. 5 narratives B, F, G and L). Also the intermediate group concerned ponderer, including forest owners who are concerned about climate change but have not identified an appropriate strategy for response, are also very likely to be found (Fig. 5 narrative K).

Overall, forest owners interviewed for this study were generally aware of climate change and its potential effects on the forest: half of the interviewees mentioned this issue without prompting. However, most of the forest owners did not report a strong readiness to change their management behavior due to climate change. Many of the comments highlighted an attitude of climate skepticism though that was not the only reason for passivity. Some elder forest owners reacted like fatalists because they saw their own efforts useless (mild fatalism), while others indicated concern but were waiting for better information about measures needed to respond to climate impacts (concerned ponderer). A common reason for passivity was skepticism that any actions they as an individual forest owner took would not have an impact on the global issue (deep fatalism).

Those forest owners who reported actions seemed to be motivated more by objectives other than concern but were able to argue that changes made were still connected to climate change as well (climate pragmatist). Some forest owners who were interested in changing their behavior mentioned monetary issues related to carbon capture. Lack of monetary support, advancing age, and lack of information are control beliefs inhibiting climate responsive actions, a deep trust to forest professionals can either support or inhibit behavioral changes depending professionals' knowledge and attitudes.

5.2. Relevance of the results for science, policy and practice

In this study forest owners spontaneously raised the issue of climate change in the discussion of their forests more often than in previous studies: 10% in the study by Eriksson (2014) while 50% in this study. This may indicate that the awareness has increased due to recent intensive climate policy discourse, but partially the reason may be the different study constellation. The theme of the interview in Eriksson's (2014) study was "risks" but in our study we focused on "change". Also, forest walks, as applied in this study, may catalyze a more diverse and nuanced narrative than a typical interview setting (see also Fischer, 2012). It seems to be notably easier to forest owners to speak about the forest in forest where they can comment on what they see and hear (Takala et al., 2017). Qualitative oriented forest research has predominantly followed "dry" interview settings, in face-to-face (e.g., Vainio and Paloniemi, 2012), phone-mediated (e.g. Guillen et al., 2015) or focus-group constellations (e.g. Salomaa et al., 2016), without explicitly discussing interviewing context as an essential factor of data quality. We warmly recommend forest walks as a data gathering method for further forest owner studies, to diversify methodological tray in qualitative forest research. Nevertheless, as the number of interviewees was in our study relatively small (20), even though comparable with many other qualitative studies, the forest owners' climate change perspectives should be interpreted as a broad example rather than a representative result. As such results serve as firm basis for designing statistically sound quantitative survey.

Landowners emphasizing potentially positive impacts of climate change were not found in Eriksson's (2014) study whereas our study make us hypothesize that a group of pragmatist forest owners may be rather large in Finland. This is yet to be confirmed in a quantitative survey study. Our results support Swedish findings (e.g. Blennow, 2012) that some of the forest owners see climate change as a risk through increasing abiotic and biotic damages. Still we cannot confirm that the forest owners who have seen negative changes in their forests will have a much higher concern and readiness to respond to climate change. This is because some forest owners interviewed in this study had a tendency to emphasize other reasons for the changes in their forests than that of climate change.

Our results indicate that among the interviewed Finnish forest owners there is a relatively low strength of belief regarding climate change, especially with that of behavioral control in their forests. Thus, so far no concern-motivated actions were taken among forest owners, neither for mitigation of nor adaptation to climate change. The

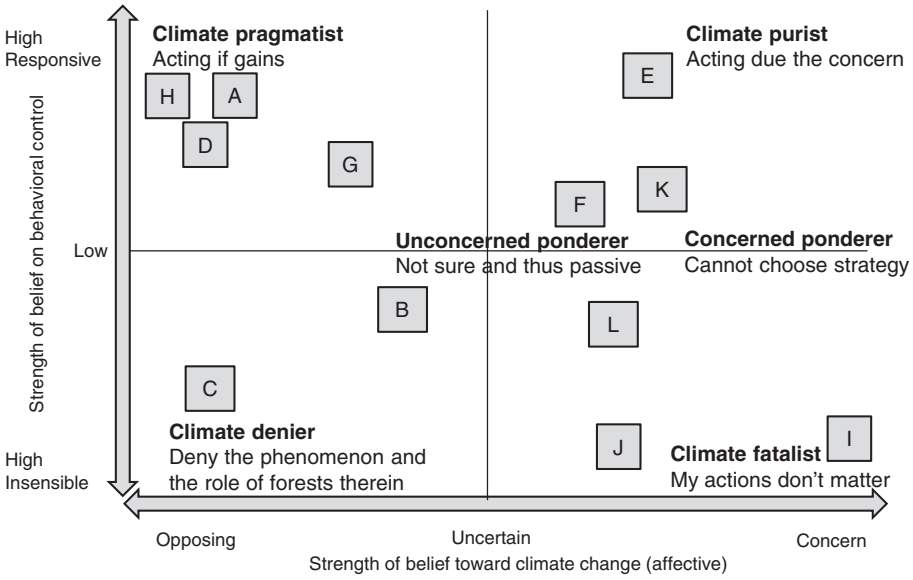

Fig. 5. Forest owners' narratives on climate change according to theoretical orientations toward climate change in their own forests (adopted from Eriksson, 2014). Letter symbols in the picture depict example quotations translated from the data of this study and presented in the figure based on the qualitative interpretation.

Cognitive structure regarding change:
A. "if you are able to utilize improved growth, you can make money." (FO8)

Affective evaluations:
B. "Honestly speaking I think that no-one really knows about this thing [climate change] either so much. But there are many people who speak as much they can. But as everyone talks in a different way, how can you know? And no-one knows at the end what will happen. Regarding this I am not very interested." (FO1)
C. "I don't know if warming means anything for trees. I don't believe that there is at least any big change going to happen for these forests due to climate change which is discussed." (FO4)

Intended behavior:
D. [… planted oak and ash because climate is now] "more favorable" [than before] (FO3)
E. that he is "carefully considering management options" on changing environment, especially with regards to logging operations (he did not used natural regeneration due to increased risk towards storm damages) (FO14)
F. "As we do not know enough we should be wide-awake [to adapt actions]." (FO16)
G. "… storm damages, impact [of them] on the human being is small … if [impacts are] essentially visible, businesses should be adapted, then time span is long, you cannot cut down all spruces but has to grow them until to end [of rotation]" (FO17)

Control beliefs:
H. "If I can get compensation [for carbon capture], why not [to participate in it]." (FO18)
I. "It [climate change] is such an issue in which I cannot much affect." (FO16)
J. "…cannot do so much anymore. I have age so much." (FO7)
K. "Yes I trust in professionals in the forest management association, for sure the information is reliable ." (FO5)
L. "Then later we know if [the information] was correct or not." (FO18)

interviewed owners thus perceived no urgent need to adapt their forest management on their own holding. This finding compares interestingly with Blennow and Persson's (2009) finding from Sweden that the lack of adaptation associated with the perceived lack of adaptive capacity, i.e. many forest owners have not adapted their forest management, even if they believed in climate change, because they do not know how to adapt. In the present Finnish case, many forest owners also used fatalist and skeptic tones or expressed opposition when asked about the risks of climate change. No one used highly concerned or action-ready language. Reason for this response may be the informants' inexperience of extreme weather events in the relatively resilient case area of Eastern Lake Finland, or lack of knowledge of possible climate-oriented actions.

Due to the qualitative nature of our study we cannot predict the size of this segment of low-climate-concerned forest owners. The exclusion of forest owners who lived farther from their forests in this study may partially influence this finding. It might be that absentee owners, who tend to be city-dwellers with higher education and less traditional forestry expertise, would be more aware and concerned of climate change effects in their forests (see also Blennow et al., 2016; Håbesland et al., 2016; Khanal et al., 2016). Regardless, the present results contrast considerably with the dominant media and forest policy discourse and calls for more profound studies.

A diversity of climate attitudes among forest owners challenges forest policy makers and calls for multiple policy measures to be launched. Understanding heterogeneous policy target group in more homogeneous subgroups may increase relevancy of policy strategies to influence their behavior (Fischer, 2012). Given the understanding that forests play an important role in climate change, both in mitigation of and vulnerability to its effects, proactive forest management measures must be enacted to increase forest resilience. Climate pragmatists are probably not ready to adopt new forest management measures requiring monetary input if those measures are not associated with

compensatory gains – recent evidence from Norway and the USA reports monetary compensation increasing carbon program participation among private landowners (Håbesland et al., 2016; Latta et al., 2016; Khanal et al., 2017). Easements, incentives, and guidance toward risk averse forestry may be influential policy measures for forest owners that are skeptical or uncertain about climate change.

The climate deniers group has a rather deep normative opposing position. Reconsiderations through interactions with trusted peers and forest professionals may be a stepping stone to influencing these forest owners. Our practical recommendation is thus the same as the one by Andre et al. (2017): forest trusted advisors should have a clear role of communicating with the owners the risks of climate change and the opportunities to adapt. This study did not particularly focus on social contexts as a source of control beliefs of forest owners. Social network was spontaneously mentioned only a few times along the interviews, which is in line with previous results that forest owners' social networks currently serve only a minimal function of sharing knowledge of climate change and adaptation (Andre et al., 2017). Still, many studies have emphasized the central role of trusted forest professionals in decision making of many Finnish forest owners (Hujala et al., 2007, 2009; Hujala and Tikkanen, 2008) and inevitably forest professionals may play an essential role also in altering the thinking of many forest owners regarding climate change, and thus primary educational efforts should be targeted toward them. Concrete examples such as model forests and other means of experience-based information sharing could act as a practical response to the informational needs of many forest owners, especially for the small but growing segment of forest owners that have strong concerns about climate change but lack knowledge regarding how to begin climate responsive management practices. Finding and empowering “early adopters” among the climate purists, to serve as examples, could gain policy goals of society widely. The search and piloting “climate-nudges” (Valatin et al., 2016), which take into account forest owners' attitudes, motivations, circumstances and behavior, may be the most influential contribution toward pro-climate and climate responsive private forestry.

5.3. Conclusions

To conclude, the following responses are given to the hypotheses of the study:

(1) Finnish forest owners discussed climate change without prompting more often than was originally hypothesized. However, a concern-driven narrative was rare as in previous studies. This study revealed clear skepticism and pragmatic attitudes. The issue of climate change was not considered urgent in general.
(2) Most forest owners did not consider climate change to have a large impact on their forests. Furthermore, some owners emphasized favorable impacts of warming instead of risks.
(3) This study supports previous findings that forest owners have not consciously adapted their management measures to respond to climate change so far, but does not support the results that those who have perceived negative impacts of climate change in their own forests are more ready for climate responsive forest practices than those who have not. Based on the results of this study we can hypothesize that a group of forest owners does not see the effects of climate change as a phenomenon behind visible changes in forests, but rather as a part of the normal fluctuations in climate.

Thus, this study provides a more diverse picture of forest owner attitudes toward climate change than previous studies in the Nordic countries. We theorized different attitudinal positions among the forest owner population. Our empirical findings predict that forest owners do not exhibit the most confident orientations regarding climate change but instead possess much uncertainty and look to the guidance of authority. Likewise, climate-skepticism exists among forest owners. Such orientations, if common in society, would have consequences for the forest sector specifically and society in general. For example, forest owners' attitudinal positions should be taken into account when developing new policy programs, as well as public and commercial services targeted to forest owners. Pro-climate and climate-responsive forestry may offer new business opportunities both for forest owners and their consultants. Regardless, based on this study we cannot go deep into discussing possible societal impacts of attitudes revealed, or into demand of new services, because according to this study we cannot predict how common different attitudinal orientations toward climate change are among the Finnish forest owner population. A statistically sound study needs to be conducted to enhance policy programs and service developments.

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